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ABSTRACT

In a study designed to explore principals' problem-solving strategies, 11 highly effective elementary school principals were compared with 11 moderately effective principals from the same three districts. The principals' effectiveness was determined by central office administrators and by application of the "Principal Profile," a measure of principal effectiveness. The first part of the study, reported in this paper, involved giving these principals a problem-sorting task and subsequently interviewing them. There were marked differences between the two groups in how they classified and managed the problems in their schools, in the strategies they used to solve problems, and in their perceptions regarding the influences of various factors on their problem-solving. The factors considered included administrative experience, personal values and beliefs, school system context, and attitudes. A three-page list of references concludes the document. (PGD)

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ABSTRACT

In a study designed to understand principals' problem-solving strategies, 11 highly effective (as judged by central office administrators, and as measured by a profile of principal effectiveness) elementary school principals were compared with 11 moderately effective principals. The first part of the study, reported in this paper, involved giving these principals a problem-sorting task and subsequently interviewing them. There were marked differences between the two groups in how they classified and managed the problems in their schools, in the strategies they used to solve problems, and in their perceptions regarding the influences of various factors (administrative experience, personal values and beliefs, school system context, and attitudes) on their problem solving.

Differences in Problem-solving Processes Used By Moderately and Highly Effective Principals

Kenneth A. Leithwood and Mary Stager

Growing recognition of the contribution some principals make to the quality of schooling[1] generated considerable inquiry in the late 1970's and early 1980's aimed at describing what principals do (e.g., Lightfoot,1983; Morris, Crowson, and Porter-Gehrie, 1981; Peterson, 1977-78; Wolcott, 1978). With the assistance of several syntheses of this research(Greenfield, 1982; Leithwood & Montgomery, 1982; Persell, Cookson, & Lyons, 1982), we now have relatively detailed information about the routine practices of principals. Evidence of distinctly different patterns of principal practices has begun to accumulate also (Hall, Rutherford, Hord, & Huling, 1984; Leithwood & Montgomery, 1986; Salley, McPherson, & Baehr, 1978) and efforts have been made to distinguish between patterns of practices which contribute more and less effectively to the quality of school life, variously defined. "Effective schools" and related research has focused especially on highly effective principal practices (e.g., Blumberg & Greenfield, 1980; Dwyer, Lee, Barnett, Filby, and Rowan, 1984; Keefe, Clark, Nickerson, and Valentine, 1983; Phi Delta Kappa, 1980; Rutter, Maughan, Mortemore, and Ouston, 1979).

Efforts by the professional and research communities to disseminate and implement the results of this research appear to be virtually unprecedented. This is certainly encouraging, given the dismal history of the spread of innovative ideas and practices. However, it confronts researchers much more acutely with questions they have usually had protracted periods of time to consider: Is the research sufficiently mature to warrant serious attention from practitioners? Have basic issues concerning its validity been adequately addressed? Is it in a form that provides a truly useful guide to practice? Recent analyses by Rowan, Dwyer, and Bossert (1982) and by Murphy, Hallinger, and Mitman (1983) do not provide reassuring answers to the first two of these questions. Nevertheless, we are inclined to believe that, as a whole, the body of research is no more culpable than most in relation to such methodologically-based criticism.

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[1] We estimate that there are about forty empirical studies directly examining the relationship between what principals do and effects on students. These studies are reviewed in Leithwood and Montgomery (1986).

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To what extent this research is in a form useful as a guide to practice is a question most germane to our present purposes. Consider the detailed descriptions of the actions of principals whose effectiveness is unknown, as provided by Martin and Willower (1981), Morris, et al. (1981), or Wolcott (1978). As a guide to practice, these descriptions provided, at best, stimulation for inferences about effective practice that would require considerable subsequent evaluation. In agreement with Scriven , we are inclined to believe that "It is a bad hangover from adulation of the physical sciences to suppose that there is something particularly important about reporting the way things are." (1980, p. 129)

Detailed descriptions of what principals do appear to be more useful, however, if these practices are known to be "effective", as in the case of Dwyer et al.(1984) and Willower and Smedley (1981). A principal interested in improving his own practices can make stronger inferences from these data on effective practices than from the previously-described data on overall principal practices. Even more useful to such a principal are descriptions of alternative patterns of practices of increasing effectiveness (e. g., Leithwood & Montgomery, 1986); these identify not only practices to be emulated in the long run but also manageable stages to strive for in the short run.

The major limitations of most of this research as a guide to practice, however, derive from its focus on largely overt actions. These limitations, furthermore, are more or less extensive depending on one's basic image of effective school administration. Suppose school administration is viewed as a technical function--applying reliable procedures or techniques to carry out a predictable set of tasks. With this image in mind, current research describing effective actions need "only" be extended to the point of identifying the knowledge, skills and attitudes guiding these actions; it might be assumed that, once identified, most can be learned and subsequently used as a guide to action. (We put the qualifier "only" in quotation marks because this extension is in itself a very ambitious undertaking.)

However, few people would characterize school administration as a technical function, even though it undoubtedly has its technical components. The bulk of educational administration theory would support an image of school administration as decision making (e. g., Greenfield, 1985). According to this image, principals are faced with a continuing series of choices to be made. Their job is to make those choices that best suit the context in which they find themselves. Alternative courses of action must be weighed against the purposes they are to serve, the beliefs, values, abilities and expectations of those touched by the choice, and the like. The value of almost any administrative act,

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then, depends upon how it stacks up against such criteria. From this perspective, current research (extended to identify knowledge, etc., in the way discussed above) contributes to improving administrative effectiveness by increasing the repertoire of alternatives potentially available to be considered by the principal. However, such research is mute concerning the relationship between actions and contexts and thus does little to help the principal in choice making. Indeed, with the exception of some case study research which explicitly identifies important contextual variables, the goal of current research has been to downplay context in favor of identifying broad courses of action which are (it is implied) effective in all contexts.

Our own research suggests that decision making may be too simple an image to convey the functioning of effective school administration. Problem solving might better capture the core of what is required. From our perspective, decision making is a relatively simple type of problem solving because it involves "merely" choosing among known solutions. Now principals are frequently involved in such decision making (just as they engage in a number of largely technical acts). But discrete technical acts and individual decisions are elements of a more comprehensive response that principals construct to solve the overall problem of achieving goals which they pursue in their schools. This problem varies in its complexity depending upon what these goals happen to be. Our reseach, for example, suggests that these goals range from "running a smooth ship" through "developing a good climate" and "implementing effective programs" to "doing whatever needs to be done in order to achieve socially valued goals for all students" (Leithwood & Montgomery 1982, 1986). It is easy to imagine contexts in which achieving even the simplest of these goals (running a smooth ship) would require the principal to do more than choose from among known courses of action. It is equally easy to imagine a comprehensive response to the problem of goal achievement being pieced together intuitively, with little recognition of the overall problem, by some principals. By others, this response is a masterful accumulation of sub-steps in a carefully worked out strategy for solving a clearly recognized problem. Variations of these sorts illustrate why we are attracted to an image of effective school administration as problem solving.

An image of the principal as problem solver makes demands on current research over and above those made by the two alternative images of school administration. This image causes us squarely to confront what the other images only hinted at: What principals do depends on what principals think.

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Descriptions of effective action at best provide a desirable set of practices to strive for in a non-contingent administrative world. But an administrator's world is contingent; dealing with it effectively involves solution creation as well as choice making. Effective solution creation depends on the metacognitive processes (problem solving strategies) available to principals to guide the uses they make of their knowledge, skill and affect.

Through this line of reasoning, we have come to conclude that descriptions of effective action, standing alone, are of limited practical value. They need to be supplemented with a more profound understanding of the internal processes giving rise to them and from which their meaning derives. Indeed, such descriptions may be counterproductive in the contingent world of school administration if their uniform application is insisted upon. The result might easily be a narrow, inflexible recipe for school leadership that severely constrains the contextually sensitive judgements of many principals, thereby reducing rather than increasing their effectiveness. Alternatively, the overt actions described by current research might be better viewed as interesting, thought-provoking examples of actions that have emerged as effective in particular contexts through the applications of more fundamental problem solving processes by principals. It is these problem-solving processes, in our view, that principals most need to learn in order to become more effective in their own--at least partially--unique school contexts. Of greatest potential value, then, are descriptions of effective problem solving (coupled with illustrations of effective actions resulting from such processes). Acquisition of such processing strategies will empower principals to act more flexibly in creating effective solutions to the overall problem of achieving their goals in their own schools.

This then is the rationale leading to the research reported in this paper. The long-range goals for this research include helping principals to acquire effective problem-solving processes. This paper, however, reports on only the first stages of the research, which had the following objectives. First, we set out to determine the nature of principals' problem solving (types of problems faced by principals, components of the problem-solving process, and ways in which principals classify problems). We also examined possible differences in the problem-solving process depending on characteristics of the problem, context of the problem (solved alone or in a group), and characteristics of the solver.

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Framework

The study reported in this paper grows out of a line of research on the principal's role which has been underway for about five years. The most substantial and visible outcome, to date, of this work has been the development of a detailed, multidimensional, multilevel description of growth in principal effectiveness (the Principal Profile) and a procedure for locating principals on the Profile. It includes four dimensions of behavior: goals (principals' intentions and their use); factors (elements of the school and classroom which principals can influence and which, in turn, influence students); strategies (actions taken to influence factors); and decision-making (processes used for choosing within each of the other dimensions). Variation among principals on each dimension has been described at four levels of effectiveness. A recent book provides a comprehensive description of the Profile, an account of its development and validation, and a tentative theoretical explanation of relationships among dimensions and variations in levels of principal effectiveness (Leithwood & Montgomery, 1986). The present study involves comparing the problem solving of moderately and highly effective principals. Characteristics of both categories of principals and methods for such classification were based on the Principal Profile.

"Moderately effective" was a designation given to principals whose goals were rather narrowly defined by managerial and/or staff interpersonal concerns; they played little role in the curriculum or instructional decision making in their schools. A limited range of decision-making forms and procedures were used in their schools, the tendency being toward unilateral decision making regarding matters about which they were most concerned and complete delegation of many other decisions. Evidence that such a pattern of practice has minimal effects on student outcomes is fairly compelling. The "highly effective" designation was applied to principals whose goals were directly linked to student growth across an ambitious array of complex cognitive and affective outcomes. These principals were intimately involved in curricular and instructional decisions and displayed situational leadership skills, with a strong propensity for extensive involvement of staff in many decisions. This pattern of practice has been demonstrated to have a substantial impact on student growth.

Our theoretical explanation of the Principal Profile is based on contemporary information processing theory, and such theory has been used also to guide our study of problem-solving strategies.

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Until recently, information processing-oriented research on problem solving has concentrated on the type or characteristics of the problem itself (particularly its "structure") and studied problems that were "well-structured" (i.e., clearly presented, with all of the information needed at hand, and with an appropriate "algorithm" guaranteeing a correct solution; Frederiksen, 1984) and/or "knowledge-lean" (i.e., involving novel situations, where specialized knowledge and skill are not required; Glaser, 1984.) (See, for example, Simon 1973, 1975.) However, several new directions are emerging in the field. First, there is increasing awareness that the solution process that is used has more to do with the solver's knowledge of a particular problem than with problem type or characteristics per se (Frederiksen, 1984). Second, because of the importance of knowledge, studies of problem solving increasingly have been conducted within specific knowledge domains rather than in "knowledge-lean" ones. Baird (1983) and Glaser (1984) provide substantial evidence for the appropriateness of this direction for research. Finally, there is evidence of more interest in "ill-structured" problems (i.e., those with indefinite goals and/or incomplete materials provided; Greeno 1976, 1978), along with an awareness of the limitations of generalizing results from research using well-structured problems to processes involved in solving ill-structured problems.

In this entire branch of cognitive psychology, there is a great deal of theoretical work but very little empirical data. What empirical work there is tends to be of two types: (a) attempts at computer simulation of processes that humans use in solving problems ; and (b) comparisons of the solution processes used by expert and novice solvers.

This work has led to the formulation of information processing models which vary slightly in detail but all generally include "problem representation" and "problem solving procedures" in some way. Over the course of time, there has been increasing understanding of the extreme complexity of both problem representation and solution aspects of the process.

One summary (Norris, 1985) of studies comparing experts and novices suggests (primarily on the basis of a study conducted by Larkin, McDermott, Simon and Simon, 1980, using physics problems) that those with more expertise: (a) possess far more information; (b) have automated many of the sequences of a problem solution; (c) use a greater variety of approaches to solution; and (d) spend more time at the beginning of a problem deciding on overall strategy. Another study with physics problems (Chi, Feltovich & Glaser, 1981) indicated that experts base problem representations and approaches to

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solution on major physics principles while novices use surface features; similarly, a study (Voss, Greene, Post & Penner, 1983) using social science problems indicated that experts isolated more abstract or general features of problems and tended to state more abstract solutions, which encompassed additional more specific strategies.

The treatment of problem structure and solver's knowledge in the recent information processing literature demonstrates the importance of domain-specific knowledge in accounting for problem-solving processes and hence has strengthened our belief that there is a need for a detailed study of problem solving by principals; little in the existing literature can be safely generalized to the principal's role. Indeed, we have only been able to locate two empirical studies (Hayes-Roth & Hayes-Roth, 1979; Voss et al., 1983) which provide accounts of ill-structured problems and/or problems concerned with everyday life (what Robinson, Tickle and Brison, 1972, refer to as "real-life" problems, the "most frequently occurring and most significant types of problems") and/or those which Scriven (1980) terms "evaluation problems". One of these studies (Voss et al., 1983) considered problem solving in the domain of the social sciences; this study's application of the general information processing model to ill-structured problems and its approach to the characterization of social science problems (considering more than "structure") has influenced the direction of our research significantly.

Our review of the literature suggested that, in addition to type of problem and its relationship to solver's knowledge, the context in which principals' problems were solved (i.e., whether alone or not) is an important determinant of the process involved. Clark and Peterson (1986), in a major review of teachers' thought processes, indicated that there appeared to be an important distinction between the kind of thinking that teachers do during classroom interaction and that done before and after such interaction; presumably, this is also the case for principals. Shulman and Carey (1984) reviewed evidence concerning the number of people involved in problem solving, and provided a theoretical argument for the importance of this dimension based on Simon's (1957) conception of bounded rationality. According to this conception, the limits on an individual's problem-solving ability, imposed by the boundaries of his/her information processing capacities, can potentially be extended through group problem-solving processes.

The final class of important determinants of problem-solving processes are individual solver

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characteristics, and work from the area of social cognition seems highly applicable to this. In a recent paper focusing on the interface between motivation and social cognition, Showers and Cantor (1985) considered the relationship between motivational elements--goals, mood, and expertise--and flexibility of cognitive strategies. This approach is promising for our work, for it suggests that strategies are strongly influenced by both goals, which we know to be the most critical dimension of the Principal Profile (Leithwood & Montgomery, 1986) and expertise, which we know from the information processing literature to be crucial in determining solution process. This approach also is able to take into account findings of the work by Kahneman, Slovic and Tversky (1982) on the importance of biases or errors in problem solving.

Method

Pilot Study

In reviewing the literature, a number of articles were examined expressly to inform the project methodology. These included articles on the validity of verbal reports about mental processes (Ericsson & Simon, 1980;Nisbett&Wilson77), reviews of available methods (Clark & Peterson,1986; Shulman & Elstein, 1975), and accounts of methods used in empirical studies (Larkin & Rainard, 1984;Penner&Voss83). This work was used in the design of a pilot study (which in turn allowed the further refinement of methodology for later stages of the work) which focused on how the number of people involved in solving a problem affects the process. Processes used by 12 novice administrators and 13 more experienced ones were compared. Subjects were asked to sort a set of 25 briefly-worded problems into three sets, those they would solve alone, with one other person, or with a group. Then they were asked to provide a detailed account of how they would solve a problem, drawn from their own experience, of each type. This study, in addition to permitting the modification of methodology had two main substantive findings.

First, the study confirmed that the problem-solving processes which principals describe using resembles the process described for the solution of social science problems far more closely than that for any other problems described in the literature. Most notably, instead of generating a number of possible solutions and choosing among them, principals tended to select a solution and then go on to argue in support of it. This finding has persuaded us to concentrate in detail on the work of Voss et al. (1983) and, with that as a basis, refine the method to be used for analysing protocol data collected in

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the present study.

Secondly, there were differences in the processes used by novice and experienced principals. The clearest of these was the fact that experienced principals stated that they would solve 52% of all problems presented to them (i.e., 52% of all the 25 problems presented to 13 principals) in a group situation, while novice principals said that they would solve only 39% of these in this way. There were marked differences, too, among individual principals' solutions, in the ways that they used the group process: in some cases, for information about a problem situation; in others, as a source of potential solutions; in others, allowing participants to actually choose the solution. The differences in group problem solving between and within experienced and novice groups were marked enough to warrant detailed further exploration.

Main Study

Twenty-two elementary school principals from three school systems were included in the main study. Eleven of these principals were considered to be moderately effective, and the remaining 11 to be above average to superior. Selection of principals and the determination of their relative effectiveness took place in three steps. In the first, two central office administrators for each school system were asked to identify those principals they considered to be exceptionally effective. Next, those recommended by both judges, and an equivalent number of moderately effective principals, were provided with information about the general purpose of the study and asked if they would be willing to participate; all but one of those approached agreed to participate. The third step involved rating the effectiveness of all principals in terms of the Principal Profile(Leithwood & Montgomery, 1986) by an interviewer who did not know the "reputational ratings" of the principals in the sample. In this step, analysis of data from a 2 1/2 hour standardized interview permitted principals' overall effectiveness to be estimated on a four-point scale. There were only three principals whose reputational ratings were discrepant with their Profile-based ratings; the latter ratings were used in these cases. Principals rated at about 2 on the scale were designated as moderately effective; the remainder, rated as 3+ or 4, were designated as highly effective.

The 11 moderately effective principals had an average of 18 years of experience as school administrators, and were in schools averaging 309 students; three of this group had vice-principals. The highly effective principals averaged 14 years of administrative experience, and were in schools

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with an average of 473 students; six of them had vice-principals.

To study problem solving, all principals were interviewed on two separate occasions, using two different instruments. Only the results of the first set of interviews are reported in this paper. The instrument used for this first set of interviews included three sets of questions. The first set referred to 25 paragraph-length case problems which were actually encountered and prepared for us by principals. These problems were provided to the 22 principals in advance of the interview, along with instructions to read the problems and to sort them into separate piles in terms of similarities of the solution process they would use. Questions in this part of the interview concerned why the principals sorted the problems as they did. The second set of questions, somewhat open-ended in nature and followed by detailed probes, focused on principals' reflections on their own problem solving, how it had changed with experience, and factors (such as values and beliefs) perceived to influence it. The final set of questions elicited information about how principals selected, from the myriad problems they encountered, those to which they assigned time and priority.

The interview instrument and procedures for its use were pilot tested, in several iterations, with 12 principals and with 10 teachers enrolled in a pre-service principal preparation course. Data were collected from the 22 principals in the main study sample by a researcher who had not been involved in the interview leading to the Profile ratings and who was unaware of the reputational rating of the principals. Interviews averaged about 1 1/4 hours ; they were audiotaped and subsequently transcribed. These interview records were then coded and content analyzed.

Results

Data from the first set of interviews with principals are reported in three clusters. The first cluster concerns the classification and management of problems by principals, the second their problem-solving strategies and the third, the influences on their problem-solving processes.

Problem Classification and Management

Data reported in this cluster were intended to answer questions about (a) the nature of problem classification systems used by principals; (b) how principals determined the priority, in terms of their own attention, to be given a problem; and (c) features of problems considered by principals in estimating problem difficulty. Figure 1 summarizes results for each of these questions.

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Elements of Classification and Management	Highly Effective Principals	Moderately Effective Principals
1. Nature of Classification	• assign more importance to "number of people involved" as a problem category • use an explicit sorting process in daily problem solving • use, as major sorting categories, who is involved and/or time	• assign less importance to "number of people involved" as a problem category • have no explicit sorting process: they "react"
2. Determination of Priorities	• give emphasis to programs, overall school directions, building staff morale and excitement about programs • provide arguments in support of priorities • work harder to manage their time to free themselves for their "proper" work (i.e., program development, planning, initiating change) • mention more specific strategies to control paperwork	• give emphasis to building or maintaining interpersonal relationships • provide little rationale for priorities • are marginally more satisfied with how they spend their time, but express desire to spend more time in classrooms, with students and staff
3. Problem Difficulty	• tend to label as easy problems, those encountered before, for which they have clear procedures • find hardest problems are those outside of their control, those impacting widely , and those concerned with staff morale • insist that there are some entirely new problems facing principals, and see clearly the ways in which problems are related to former similar ones	• find hardest problems are those involving teacher firings or other less critical personnel problems • tend to view most problems as familiar or "old", and display a greater tendency to be bored by them

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Figure 1: Principals' Problem Classification and Management

In order to determine the nature of problem classification systems, the initial questions in the interview concerned how and why the principals had sorted the 25 case problems as they did. Moderately and highly effective principals differed little in the time taken for sorting, using about forty minutes on average. In addition, few differences were evident in the number of categories these principals used (five on the average) or in the categories themselves. Both groups of principals used the following categories: number of people involved; nature of people involved; amount already known about the problem; timing or urgency of the problem; content of the problem; and the principal's role in the problem. One highly effective principal also used "source of problem" as a category, and one moderately effective principal used "degree of control over the solution".

Differences between the two groups of principals on the problem sorting task were evident, however, in the emphasis awarded the category "number of people involved"; all 11 highly effective, but only eight moderately effective, principals sorted using this category. Further, in response to questions about sorting real problems that occurred in their school context, moderately effective principals appeared not to have an explicit process for problem sorting. As one principal said:

> To be honest with you, I really don't. I don't think of things and try to put them in slots. I try to deal with a problem when it comes and I don't believe in delaying. If somebody is really upset about something, I want to know right then and there, I don't want to leave it for half an hour, or go home and think about it...

In contrast, highly effective principals quite consciously used an explicit strategy for sorting in their daily problem solving. For example:

> Yes, I do. I'm fairly conscious of that...I have a VP in the school and she knows where I'm coming from, and I ask her to help keep me on task. Last night at the divisional meeting we were reviewing our report cards. I outlined some of the modifications we had made...and that was strictly a "review-tell" decision. Now I then moved into an area of evaluation...[cites an example of problem and process used]...That was getting into a somewhat of a "sharing" but it was kind of mixed because I was laying on what I think is somewhat of a base from which to work...

Some highly effective principals who sorted problems according to who would be involved in them did such sorting according to organizational groups (e.g., "file it for the lead teacher meeting", "file it for the staff meeting"); others sorted in terms of type of decision (e.g., "tell" vs. "sell" vs. "share"), role responsibilities (e.g., a "teacher-owned" problem), or numbers involved (e.g., joint problem vs. individual problem). The main point seems to be that these principals had some way of consciously discriminating among problems and consistently applied this to assist in their problem management.

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Moderately effective principals did not.

Another component of problem management addressed by our data was how principals decided priorities among problems in terms of their own time allocation. All principals were concerned about student and staff needs and felt overburdened with paperwork, identifying this as something preventing them from spending as much time as they would like on other priorities. Highly effective principals tended to award priorities to problems impacting on the school program and on overall school directions (without ignoring the problems of individuals). When asked about problems which were given priority by him, one principal said:

> ...ones that are going to have great impact on people, in terms of cooperation. A problem that impacts on one person versus one that impacts on the whole school, I see quite a difference in approach to that, in terms of time and the amount of communication involved because you're dealing with so many people.

Moderately effective principals, when they established priorities among problems, tended to do so on the basis of which group of people was involved. As an example of this, one principal stated:

> ...any problem that is going to affect the kids gets priority. Then, after that, if it affects staff...and then head office gets to the bottom, unless head office is saying "Get the report in by three days time!"

Some principals also set priorities in terms of deadlines, order of arrival, or amount of time required for solution. One moderately effective principal said "No, I can't say that I have any way of deciding what gets done first."

As compared with moderately effective principals, their highly effective peers seemed to have more deliberate strategies for managing their time and for ensuring that time is available for high priority problems. As one example from a highly effective principal:

> I use my planning book. What I do as things come in to me, I look at urgency for one thing. If there are matters from the school board, in terms of doing surveys and things like that, they're not that critical to me, I must say. I do deal with them, and I deal with them on the proper timeline and get them in as they are required. But they're not crucial to me. So those kinds of things maybe take a B role, as opposed to an A role. There are certain things that are required for us to function as a school, and they are A priorities to me...and I put them in my planning book that way, and I try to deal with them on a regular basis. I try to look at moving things from one day to the next, in dealing with the A priority first, and if I still have time, I go to the B. If not, I end up taking the B home...The B items which aren't crucial to our functioning, I may take home. They may be necessary to the board, but in terms of me, and the school, and our staff and students' functioning, they are not that critical. So I look at things I need to do that keep this operation going smoothly, and those are the items that I'd deal with.

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As another example,

> ...I have to come in about 7:15 to deal with my items and there is a chunk of the day that I can also work on my items once the programs are started...

However, these strategies of highly effective principals extend beyond daily time management routines. One highly effective principal described the importance of predicting what the problems will be and thus preventing their occurrence. He noted that many "crises" are the result of not being prepared:

> ...when that happens, you can find that you are spending most of your time [during a term] dealing with it because usually if one thing has gotten out of whack, so has another...Usually during that time, while you're kicking yourself, you're saying "That's not going to happen again next term!" You are preparing yourself and you are predicting...

This approach to time management may also be viewed as a problem prevention strategy. Differences between moderately and highly effective principals in problem prevention strategies such as these were pronounced. Much more than the moderately effective group, highly effective principals were explicitly concerned with and had more strategies for preventing unwanted problems from arising in the first place. For example, they were out of their offices, around the school and in classrooms regularly and frequently; this allowed them to detect the early signs of discipline problems, instructional problems, and the like. They attempted to focus staff on program initiatives that were exciting and absorbing, thereby reducing the likelihood of staff morale problems. Most of these principals, furthermore, were quite aware that developing excellent program instruction not only contributed to student growth but also prevented many parental complaints from arising.

As a final perspective on problem management, principals were asked about the types of problems they found easiest and most difficult to solve. Both groups of principals identified the easiest problems as "the straight paper tasks where you have to investigate and make a report ...(even though those are not the jobs you like doing)." These problems can often be solved by the principal alone and usually concern mechanical or technical aspects of running the school. Student discipline problems were also considered easy by both groups. The hardest problems for both involve other people under conditions of conflict and stress (e.g., "where people could get hurt", "where you have to fire someone", or "inter-staff problems"). Highly effective principals differed from the moderately effective (six cases vs. none) in identifying the existence of clear procedures and prior knowledge as an important explanation of problem difficulty. The two groups of principals also differed in their perception of the

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novelty of the problems they encountered. Certainly, principals in both groups could cite examples of new problems, but moderately effective principals were more inclined to subsume current problems under familiar experiences:

> There's a strong similarity within the total range of problems...One that is brand-new does not come to mind. In fact I sometimes say to myself, "I was doing this exact same thing twelve years ago, and my life is gone", which is true. There is a lot of caretaking, when you solve something in one school, and it comes up again in another.

This comment also reveals some boredom with the job, and this was never evident among highly effective principals. Typical of their response was the laughter and "definitely not" of one of these principals when he was asked if he had seen all the problems before. He quickly described three he had recently encountered that were absolutely new in his experience.

By way of summary, highly effective, as compared with moderately effective, principals classify and manage their problems by:

- assigning more weight to problems which are likely to be solved through the involvement of larger rather than smaller numbers of people. These problems seem likely to be more complex and time-consuming to solve;
- using a much more deliberate and explicit sorting process. This is symptomatic of a generally more reflective posture toward problem solving as a process in its own right;
- giving more priority to problems impacting on school programs, overall school directions and staff as a whole than to problems with much narrower impact;
- systematically using more explicit daily routines for managing time as well as predicting potential future problems and acting to prevent them from becoming time-consuming crises. These techniques create the opportunity for principals to devote attention to high priority problems;
- focusing on the availability of clear problem-solving procedures, where knowledge permits, and recognizing those aspects of problems that are truly novel and should be treated as such.

Problem-solving Strategies

Data reported in this section address questions concerning principals' overall problem-solving strategies, the specific nature of strategies used, and the role of knowledge in principals' solution processes. Results are summarized in Figure 2.

The primary data concerning overall problem-solving strategies of principals were responses by principals to the direct question (mid-way through the interview), "How would you characterize your

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Components of Strategy	Highly Effective Principals	Moderately Effective Principals
1. Overall Style	• refer more often to solving problems with others (e.g., "collaborative", "shared")	
	• are "front-end" risk-takers, but careful information collectors	• are "tail-end" risk-takers, and less careful to collect comprehensive information
	• are more reflective about their own style and process	
2. Specific Strategies	• use a more deliberate model for problem solving	• tend to use more imprecise "rules of thumb"
	• agree that any strategy must include certain elements (i.e., communication, participation by stakeholders, extensive information collection)	
	• clarify many facets of problem-solving situation (e.g., type of problem, own position, own and others' roles)	• may use strategies (e.g., not delaying) which prevent much clarification
	• have organizational structures in place for group problem solving	
	• have, as reasons for involving others, those cited by moderately effective principals and: to help with school-wide problem management; to produce better solutions; to help other staff develop as problem solvers	• have, as reasons for involving others: to gather better information; to increase ownership; to (less often) "bounce off solutions"
3. Knowledge	• list more crucial knowledges (e.g. of resources outside school, of self) and skills (of problem solving, of communication, of leadership)	• regard, as crucial, knowledge of staff and their strengths and weaknesses, and "people skills"
	• list more specific sources of knowledge (especially other principals' experiences and networks outside of school and system)	• rely on smaller number of sources, often only staff in own school

Figure 2: Principals' Problem-solving Strategies

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problem-solving style?" Although references to relationships with other people were included among the responses of both moderately and highly effective principals, this was a much more pronounced tendency among the highly effective group. Only two moderately effective principals mentioned such relationships; other responses from this group included, for example, "democratic and laissez-faire", "avoiding confrontation", "within board policy", and "don't know". In contrast, the descriptions provided by nine of the 11 highly effective principals included a central role for other people; they used such phrases as "consultative but not wishy-washy", "a cooperative effort", "rule by consensus", "shared and collegial", and "helping others solve problems". In addition to this dimension of style, the highly effective sample included references to "common sense", "staying calm and cool", and "eclectic".

Most of the highly effective group also stressed the importance of collecting information to facilitate the finding of suitable solutions. Indeed, these data raised questions about the often discussed idea of risk-taking among leaders and led to a re-examination of the data from that perspective. The results suggested that there were major differences between the moderately and highly effective principals, not in the propensity to risk-take, but in where, in the problem-solving process, the risks are taken. Highly effective principals in our sample can be viewed as "front-end" risk-takers in the sense that they defined their problems in quite comprehensive and fundamental ways: they risked tackling big problems. However, their solution processes thereafter were as free from risk as possible. Information was gleaned from many external sources, and everyone likely to have something useful to contribute was involved in some way in the solution process. The moderately effective principals in the sample, on the other hand, were "tail-end" risk-takers. They usually focused their efforts on relatively superficial problems, problems that did not seriously challenge the current status of the school's instructional program. However, their subsequent solution processes were often risk-full; that is, they were based on fairly limited sources and amounts of information and frequently did not draw on many staff who might have been able to contribute to an effective solution.

Finally, with respect to overall style, the highly effective principals were much more aware of their own problem-solving style and, without exception, could describe it easily. Only three of the moderately effective principals demonstrated a comparable degree of reflection on and control over their own processes.

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Principals' responses to a question concerning what they always tried to do to ensure successful problem-solving outcomes provided data on the nature of their strategies, specifically, on the processes themselves, on how they involved others in problem solving, and on the reasons for such involvement.

The processes used by moderately and highly effective principals differed in three respects. First, highly effective principals all appeared to use a fairly deliberate problem-solving model to guide their strategy and this model usually suggested an optimal sequence of steps to solution. For instance:

> I've learned not to jump...and not to assume, so what I do is I move around if there is a problem, and give them the benefit of the doubt, in a positive vein...And then I start gathering data, speaking to people, checking back to records, trying to put a picture together. And then I sit down with the main actors involved and try to walk through it.

The responses of moderately effective principals indicated many rules of thumb kept in mind while approaching a problem--"be proactive", "try to solve on the spot", "check board policy", "compromise"--but not a model or sequence of steps.

Secondly, there was more agreement evident in the responses of highly, as compared with moderately effective principals, concerning the elements that must be included in any strategy for it to be successful. These elements included: communication with all those touched by the problem; some form of participation in the process by all those with a stake in the problem; and the collection of as much information as was feasible.

Finally, highly effective principals devoted much more attention to initial clarification than did their moderately effective colleagues. They were concerned to clarify, for example, the type of problem they were facing (e.g., individual problem vs. joint problem, staff problem vs. lead teacher problem), their own position concerning the problem, and the role they should play in the problem-solving process. In contrast, two of the moderately effective principals were quite explicitly concerned not to delay in getting on to a solution, thereby cutting off the possibility of much problem clarification. A third usually checked out, with others, solutions he had already arrived at himself; this also seems likely to have prevented others from contributing to the initial definition and clarification of the problem.

Most principals involved others in problem solving in some way with some problems, although such involvement was much more pronounced among highly effective principals, as has been reported

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already. Principals differed considerably in how they arranged such involvement. Moderately effective principals showed some tendency to involve people on a problem-by-problem basis, creating ad hoc, informal organizational structures that were often relevant only in relation to a single problem. Most of the highly effective principals in our study had formally established structures to provide routinely for group problem solving: they had structures such as staff planning committees, principal's cabinets, and divisional organizations of teachers. The development of these structures appears to depend on the ability of the principal to anticipate recurring future problems and classify problems according to whom they might affect and who is able to contribute to their solution. These are processes which, as we reported in the section on problem management, are characteristic of highly effective principals.

Several of the reasons for involving others in problem solving were common to both groups of principals. These were: to gather better information; to increase ownership in the solution; and (less frequently) "to bounce off solutions". However, highly effective principals offered three additional reasons which help to explain the nature of the involvement they were concerned with. These principals, first of all, involved staff in many more school-wide management decisions than did the moderately effective group:

> I'm not afraid to take things to staff and let us, as a staff, work with it and develop it. If it's a decision that I need to make and it impinges just specifically on me, then I certainly do that, but I still want to share that decision with staff and run through some of the details of it with them.

Secondly, highly effective principals involved staff because they genuinely believed that such involvement would lead to better solutions:

> I think that to try to solve problems without having all the data, you are not likely to be too successful...I try to check my perception of things with people that I have some regard for...my staff...

This reason was mentioned only rarely by moderately effective principals. Finally, almost all highly effective principals appeared to view staff involvement in a specific problem as an opportunity for those staff members to increase their own problem-solving skills for the future.

Problem-specific knowledge appears in our own results (and in the results of many other investigators) to play a key role in discriminating problem-solving effectiveness. We noted earlier, as well, that effective principals viewed it as the basis for deciding about the difficulty of a problem. For

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these reasons, principals were asked to identify the knowledge they considered most crucial for problem solving and the sources of knowledge on which they relied. Both groups of principals agreed that knowledge about people, particularly about the strengths and weaknesses of their staff, was crucial--along with the skills to work with staff members. As compared with moderately effective principals, the highly effective group as a whole listed more "crucial" knowledges. More often than the moderately effective group, they mentioned: knowledge of resources outside the school; knowledge of self; and knowledge about effective communication, problem solving, and leadership. They more frequently mentioned skills other than "people skills".

The two groups of principals also differed considerably in the sources of knowledge they reported seeking out during the problem-solving process. The highly effective group relied on numerous, well-defined sources and emphasized, in particular, the experiences of other principals and networking with others outside of their schools and school systems. They also stressed their personal responsibility for acquiring this knowledge:

> You have to be well read and that's one of the frustrations I find in my job is finding time to do that. But I always save the time somewhere, generally weekends, to get reading in...You have to subscribe to some good educational periodicals.

Moderately effective principals, in contrast, looked to a small number of imprecisely identified sources, usually staff in their own schools. One principal's response is especially indicative of the limited role of (especially, formalized) external knowledge in problem solving. After noting that he had completed a Master's degree, he concluded that perhaps more important was:

> ...the school of hard knocks. You ply your trade and you get bumped around. Sometimes you learn from it...

As compared with those of moderately effective principals, the problem-solving strategies of highly effective principals can be summarized as follows:

- having an overall style which provides a more central role for others (consultative, collaborative, shared problem solving);
- devoting greater effort to systematically collecting information relevant to the problem;
- exhibiting greater tendency to risk defining large, significant problems but to solve them through a very methodical, risk-less process (i.e., "front-end" risk-takers);
- guided by a more explicit, conscious model of the problem-solving process, one which includes an optimal sequencing of steps;

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- giving greater attention and time to initial problem clarification;
- establishing more formal structures to facilitate the problem solving of staff in both short and long term;
- assuming that a major reason for staff involvement is to produce better solutions;
- drawing on larger amounts of knowledge from more sources external to the school and school system.

Influences on the Problem-solving Process

A third set of interview questions was intended to elicit principals' opinions concerning some of the factors that influence their problem solving. The pilot study suggested that four types of factors were worth further scrutiny: administrative experience, values and beliefs, the wider school system context within which principals worked, and attitudes toward problem solving. Figure 3 summarizes results concerning these factors.

All principals reported that their problem solving had changed with increased administrative experience. Several principals in both the moderately and highly effective groups suggested that they had slowed the process down:

> [In the past]...I tended to overreact and not get enough data. Now I sit back and try to divorce myself from the problem and ask myself, "Do I have enough information?" I used to jump in and put my foot in my mouth.

Moderately and highly effective principals, however, differed in how their problem-solving processes had changed with experience. The moderately effective group (specifically, 8 of the 11 principals in this group) perceived that they had become more skilled at involving other people and that they did involve more people now than in the past. The highly effective principals (who did, in fact, also involve many others in the process) reported that the most significant change in their problem solving involved becoming more consciously aware of their processes and better able to conceptualize and refine these processes. The following exemplify responses from highly effective principals:

> It's more clearly defined to me...in terms of being able to understand how I am going about problem solving. I'm much clearer in terms of how to handle it...

> You can see a situation that demands a certain type of decision, or a particular approach. You can conceptualize it a little bit quicker. You can see the beginning and the end a little easier than you did before.

Both groups of principals attributed substantial influence on their problem-solving process to

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Categories of Influences	Highly Effective Principals	Moderately Effective Principals
1. Experience as an Administrator	• report, as main changes, more reflection on problem solving and a more refined, considered process	• report, as main changes, more involvement of others in problem solving and more skill in accomplishing this
2. Personal Values and Beliefs	• are better able to articulate values • focus more on their own and staff "responsibilities"	• are less able to articulate values • do not appear to be aware of making decisions with reference to principles or values
3. School System Context	• are more aware of needs and requirements of board as a whole • are influenced, by board's encouragement, to act autonomously but with high performance expectations • value board for resources it provides to assist with school-level problem solving	• are less aware of system's needs and requirements
4. Attitude toward Problem Solving	• are definitely aware of problem solving as an activity • enjoy new problems, and see problems as opportunities • are confident, but realistic about inevitability of making some mistakes	• little sense of problem solving as an activity, and may even reject idea of "designed" problem-solving strategies

Figure 3: Influences on Principals' Problem-solving Processes

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their basic values and beliefs. There appeared to be few differences between the two groups with respect to the role of general moral values; honesty and sincerity ("don't be manipulative"), fairness in dealing with others ("golden rule"), and a respect for human dignity and happiness were cited by a majority of all principals as important influences on their problem solving. Both groups seemed similar, as well, in the importance they attached to personal values ("life priorities", "one's own upbringing"). The two groups did differ, however, with respect to the influence of beliefs concerning principals' role responsibilities. While many in both groups believed that they ought to give others some responsibility for problem solving and to support them in that activity, highly effective principals identified additional beliefs about their own responsibilities (e.g., encouraging teacher growth, leading, demonstrating commitment) that influenced their processes. They seemed clearer about these responsibilities and their practical consequences in their daily work. Two excerpts from the interviews illustrate the nature of several of these beliefs:

> I try to model. I don't just say "Do this, do that." Recently I told the junior division [teachers] that I'd encourage them to move to each other's rooms, to see what the other person is doing. I could have left it at that but instead I have offered to go in and cover classes so that they can do it. So part of it is showing that you as the principal are willing to go your mile. You have to model.

> Whatever it is we do, it has to be based on whatever we're doing for kids. That belief, I think, helps me make decisions. When I look at a problem, one of the first questions I ask myself is "How will this benefit students?" And if it's related to staff, specifically, "How will this benefit the entire staff?" So with these foundations, it makes decisions a heck of a lot easier. If I can't come up with a reason, I start to look at it as maybe not worth doing.

Both groups of principals reported being influenced in their problem solving by the larger school system context in which they work. The way the school system treats the principal appeared to influence the way principals treat their staff. Moderately and highly effective principals appeared to differ, however, in their awareness of larger school system needs and requirements and in the way that these influenced problem solving. Highly effective principals had more such awareness and attempted to take such system needs and requirements into account in their problem solving processes. These principals were influenced by their school system's encouragement to act autonomously but with high performance standards. They valued the larger system for the resources it could provide for school-level problem solving.

The final set of data about influences concerned principals' attitudes to problem solving. Marked differences between moderately and highly effective principals were evident in these data. Six of the

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11 principals in the moderately effective group demonstrated little sense of problem solving as an activity in its own right. Indeed, one of these principals was explicitly opposed to "designed" problem-solving strategies, and another insisted that there aren't such strategies at all. In contrast, the highly effective group were, as already reported, quite aware of their strategies. They also tended to see problems as opportunities to further their ends, and enjoyed the challenge of new problems. These principals appeared to be confident about their problem-solving abilities but realistic about the inevitability of making some mistakes.

By way of summary, our data concerning influences on problem-solving processes suggest that highly effective principals:

- with administrative experience, become more reflective about their own processes and refine these processes over time;
- although similar to moderately effective principals in general moral values and in personal values, are more influenced by their beliefs concerning principals' roles and responsibilities, and are more able to specify day-to-day consequences of such beliefs;
- are more aware of school system needs and requirements and try harder to take them into account in school-level problem solving;
- derive more personal enjoyment from problem solving and, partly as a consequence of this, are more proactive in dealing with school problems.

Conclusion

Several sets of data were collected from a sample of 11 moderately effective and 11 highly effective elementary school principals in order better to understand principals' problem-solving strategies. Only the results of a problem-sorting task and a follow-up, 1 1/4 hour interview were reported in this paper. Issues addressed by these data included the ways in which principals classified and managed their problems, specific strategies used in problem solving, and influences on principals' problem-solving processes. The sample size, the self-report nature of the data collected and the preliminary, incomplete (i.e., according to our research plan) nature of the data set argue for tentativeness in interpreting and using the results. With such tentativeness understood, the results appear to meet the objectives of the study and to lend support to a number of the hunches which originally gave rise to it.

First, the data do appear to be very useful in helping us to understand the sources of effective

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principal action. Moderately and highly effective principals demonstrated substantial differences in their approaches to problem solving, for example, in the care given to defining problems, in the degree to which problems are predicted and prevented, in the amount and quality of information used in problem solving, and in the degree of conscious control exercised over the process. These differences provide highly plausible explanations as to why actions taken by those principals designated as highly effective have the positive impact on their schools that they do.

Secondly, the strategies used by effective principals are not particularly complex or difficult to understand, once they are described. Indeed, our data suggest that highly effective principals have found relatively simple "macro" procedures for problem solving that reduce, for them, extremely complex social problems to more manageable ones. For example, they sort problems according to who is involved and how many people are involved; then, they make sure that all of those people are involved in clarifying the problem to their satisfaction and in contributing to the solution generation process. Further, they make sure that planning for future predictable problems is done well in advance and that structures are routinely in place to facilitate problem solving when such problems actually arise. In this way, they reduce dramatically the number of "crises" they have to face. These relatively straightforward "macro" procedures encourage us in the belief that less effective principals can be helped to become more effective by learning such procedures.

Finally, our data may eventually provide some promising insights, of a more general nature, into real-life, untidy, social science-like problems about which little empirical data is available. To generate these insights, it will be important to make links, more explicitly than we have in this paper, between the processes used by principals and the theoretical constructs being used by cognitive scientists in current work on problem solving. This seems quite feasible. For example, principals' responses to many of our constructed problem situations suggested that their knowledge was structured in a way quite consistent with what Schank and Abelson (1977) call "scripts" and "plans". Effective principals' extensive use of other people in problem solving also suggests that they cope with their own "bounded rationality" (in Simon's terms) by using a procedure which Shulman and Carey (1984) find theoretically quite compelling. As another example, although we did not explicitly seek out such information, there is evidence in our data of several sources of the errors which Kahneman et al. (1982) have reported as limiting the effectiveness of human problem solving. As an example of this,

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moderately effective principals, in particular, appeared to be unduly attracted to "vivid" problems (those with high emotional content and immediacy) at the expense of dealing with less vivid but more fundamental (instructional) problems. Such principals, when they encountered new problems, also tended to err on the side of seeing only similarities and ignoring differences from previous problems; this error can easily produce quite inappropriate solutions. In our subsequent work, we intend to link our data more closely to such theoretical constructs.

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